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Effect of organic and inorganic fertilizer on sustainability and profitability of hybrid rice (*Oryza sativa* L.)

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Abstract
A study on "Effect of organic and inorganic fertilizer on growth and yield of hybrid paddy (*Oryza sativa* L.)". Research was carried out at Rama University in Kanpur, Uttar Pradesh, India, during the *kharif* season in the year 2022. Three replications and a Randomized Block design were used to set up the experiment. Eight treatments *viz* T_1-Control (No application of fertilizer), T_2-50% Nitrogen (Urea), T_3-75% Nitrogen (Urea), T_4-100% Nitrogen, T_5-50% RDF + Vermicompost (1.5 t ha^{-1}), T_6-50% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}), T_7-75% RDF +Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) and T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1})+ Vermicompost (2.5 t ha^{-1}) + PSB were allocated in randomly. Higher growth attributing characters at different crop stages and yield attributing characters at harvest *viz.* plant height, dry matter accumulation, No. of tillers m^{-2}, & number of panicles m^{-2}, panicle length (cm), test weight number of grains $panicle^{-1}$ were produced in rice with 75% RDF + Green leaf Manure (2.5 t ha^{-1})+ Vermicompost (2.5 t ha^{-1}) + PSB treatment. Similarly, higher grain, straw yield highest harvest index, quality parameters (protein) along with maximum uptake of nutrient & net monetary income was recorded under combination of organic and inorganic fertilizer's (75% RDF + Green leaf Manure 2.5 t ha^{-1} + Vermicompost 2.5 t ha^{-1} + PSB) dosses in rice crop. In terms of benefit cost ratio treatment T_7-75% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) was produced maximum B: C ratio.

Keywords: RDF, FYM, PSB, inorganic, fertilizer, organic, growth, yield attribute, vermicompost

Introduction
Rice (*Oryza sativa* L.), a staple grain for more than 50% of the world and the most important crop in India in terms of crop output, area covered, and yield, touches the lives of millions of people. Approximately 162 Mha of the world's land surface is covered with rice, with a massive production of 503 Mt and an average yield of 4.67 t ha^{-1}. About 4.41 t ha^{-1} of rice are produced in Southeast Asia each year (FAOSTAT, 2020) [8]. In India, rice production makes up 43% of all food grain output and 46% of all cereal grain production. Rice production is 121 Mt, there is 44 Mha of rice planted and the productivity is close to 2.80 T ha^{-1} (Anonymous, 2020) [2]. In Bihar, there are 3.3 Mha of rice fields, and 8.08 Mt of rice are produced, yielding 2.50 t ha^{-1} Rice gives 21% worldwide human per capita energy and 15% per capita protein. In addition, rice grain and rice straw are significant creature feed as well as biofuel assets in numerous nations (Pode, 2016) [14]. Rice is the main plant species whose genome has been completely planned and it has also played a significant role as a model system in plant science. Manure usage became uneconomical due to the use of unbalanced or potentially inappropriate additives, which also had negative effects on the quality of the air and groundwater, which put human health at risk and caused environmental change. Then again, supplement mining has happened in many soils because of absence of reasonable manure sources and where less or no natural deposits are gotten back to the soil (Aulakh, 2010) [4]. To satisfy extended worldwide need for food by 2050, farming harvest creation should increment by a further 50 to 60% from current levels (Alexandratos and Bruinsma, 2012) [1]. Organic fertilisers are compounds that are naturally occurring in some kind of animal or plant, including animal waste, green fertilizer, crop deposits, and more. Being made of waste materials lessens the importance of agricultural output from a financial standpoint. The natural excrement serves as a repository for nutrients, particularly nitrogen, which increases the dirt's capacity to hold water and circulate air.

It also has a significant impact on the dirt's trade capacity, as well as its state and level of richness. The nature of soil and yield efficiency are greatly enhanced by soil microorganisms.
The cultivation method used for organic food production must maintain and replenish the soil's fertility. Organic food is produced without the use of artificial manures and pesticides. Regularly used as green manure, dhaincha (*Sesbania aculata*) may add 120-175 kg N/ha. An emphasis is constantly placed on the transition towards organic nutrition sources and the control of biological stress in order to reduce such concerns with crop production potential. The organic package of crop cultivation uses green manuring, biofertilizers, FYM, compost, vermicompost and other organic sources of nutrients. It has been discovered that applying various organic and inorganic sources has a significant impact on achieving high yield, greater economy, and increased soil residual fertility.

Materials and Methods

The field study was carried out during *kharif* season of 2022 at Agricultural Research Farm, of Rama University, Mandhana, Kanpur Nagar (U.P.) which is situated in the alluvial tract of Indo-Gangatic Plain in central part of Uttar Pradesh between $25^0$26′ to $26^0$58' North latitude, $79^0$31′ to $31^0$34' East longitude and on the altitude of 125.9 meters. The irrigation facilities are adequately available on this farm. The farm is situated in the main campus of the university. During the cropping season maximum temperature ranges from 27.7 to 40.7 ^{o}C, while the lowest temperature ranges from 16.7 to 27.1 ^{o}C. During the cropping period, relative humidity ranged from 41 to 95 percent. During the trial, average wind speeds ranged from 1.9 to 7.9 km hr^{-1}. During the testing period, the trail location got a total of 832 mm of rain in one wet day, providing favourable conditions for crop development. The experiment was laid out in Randomized Block design with three replications. Eight treatments *viz* T_1-Control (No application of fertilizer), T_2-50% Nitrogen (Urea), T_3-75% Nitrogen (Urea), T_4-100% Nitrogen, T_5-50% RDF + Vermicompost (1.5 t ha^{-1}), T_6-50% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}), T_7-75% RDF +Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) and T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1})+ Vermicompost (2.5 t ha^{-1}) + PSB were allocated in randomly. The source of nitrogen, phosphorus and potassium were urea, di-ammonium phosphate and murate of potash respectively. The soil of the experimental site was clay loamy in texture, low in organic carbon (0.40%), available nitrogen (166.53 kg ha^{-1}) and medium in available phosphorus (18.73 kg ha^{-1}) and potash (266.27 kg ha^{-1}) with slightly alkaline in reaction (8.2 pH). Certified seeds of rice-variety Narendra Sankar Dhan 2 was spread in the rice nursery of 50 m^2 area. This area was prepared using cross-harrowing followed by puddling to achieve proper wet-nursery situation. 20 days-long old rice-seedlings were manually transplanted. Single-seedling per hill was transplanted. Between each row, there is a 20 cm space, and between each plant, there is a 15 cm space. For weed management cost-effective chemical weed-management approach was adopted where Pendimethalin at 1000 kg ha^{-1} was sprayed at 2 days after transplanting (DAT) later spraying of Bispyribac Sodium at 20 g ha^{-1} at 20 DAT. Manual-harvesting was done at maturity-stage during 118 days of the crop. For data analysis, net plots avoiding border-effects were harvested and sun-dried for 3 days followed by manual-threshing at threshing floor and winnowing with the help of the winnower. Afterwards, the seed and straw yields were documented and presented in this research-work.

Results and Discussion

Effect of treatments on growth attribute of rice

The data plant height as affected by organic and inorganic fertilizer is presented in (Table. 1). Tallest plants (111.3cm) at harvest were recorded with T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB and minimum plant height (67.8 cm) was recorded under treatment T_1-Control (No application of fertilizer). The positive impact of fertilizer on plant height appeared to be caused by the combination of organic and inorganic sources, which resulted in fast cell division and elongation. Application of organic and inorganic materials considerably raised the height of the rice plant. Many studies, including (Siddaram *et al.* 2010 and Bharat Lal *et al*. 2014) [15, 6] have also reported on it. Higher dry matter accumulated was recorded under the T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB. However, the minimum dry matter accumulated were found with T_1-Control (No application of fertilizer). The increase in the dry matter accumulation production in rice may be attributed to the proper supply of balanced organic manure and inorganic fertilizer, maximum plant height and number of tillers (Ashwini *et al.* 2015 and Harikesh *et al*. 2017) [3, 10]. Similarly, number of tillers m^{-2} was found with organic and inorganic practices application of T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1})+ Vermicompost (2.5 t ha^{-1}) + PSB; which might be as a result of the fact that different organic and inorganic combinations as a result of higher protoplasm content in plants and quicker metabolic processes. The additional nitrogen promoted vegetative growth, which led to an increase in tillers. (Venkatesha *et al.* 2015 and Mahmud *et al.* 2016) [16, 13].

Table 1: Effect of treatments on growth attribute plant-nutrient-uptake of rice

Treatments	Growth attributing characters			Plant-nutrient-uptake		
	Plant height (cm) at harvest	Dry matter accumulation (q ha^{-1}) at harvest	Number of tillers (m^{-2}) at harvest	N uptake (kg ha^{-1})	P uptake (kg ha^{-1})	K uptake (kg ha^{-1})
T_1-Control (No application of fertilizer)	67.8	78.22	264.6	78.5	11.1	79.6
T_2-50% Nitrogen (Urea)	98.7	100.56	340.8	115.6	12.3	112.3
T_3-75% Nitrogen (Urea)	99.6	105.03	345.4	118.4	13.5	118.8
T_4-100% Nitrogen	100.6	115.49	355.4	123.0	14.9	123.7
T_5-50% RDF + Vermicompost (1.5 t ha^{-1})	98.8	104.03	339.8	114.6	21.0	111.4
T_6-50% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1})	103.6	125.47	368.1	130.5	24.2	127.2
T_7-75% RDF +Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1})	108.8	131.27	383.9	133.2	25.2	132.0

T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB	111.3	142.41	392.6	144.7	29.1	144.3
SE ±	2.35	2.52	7.7	3.5	1.1	4.2
CD (at 5%)	7.2	7.11	23.0	10.4	3.4	12.5

Table 2: Effect of treatments on yield and yield attribute of rice

Treatments	No. of panicles m-2	Panicle length (cm)	Total no. of grains panicle^{-1}	Test weight (g)	Grain yield (q/ha)	Stover yield (q/ha)	Harvest Index (%)
T_1-Control (No application of fertilizer)	230.2	16.8	136.6	23.9	30.36	56.29	35.04
T_2-50% Nitrogen (Urea)	308.6	17.3	148.5	25.2	42.65	68.26	38.45
T_3-75% Nitrogen (Urea)	316.9	17.1	151.4	25.2	44.91	70.53	38.90
T_4-100% Nitrogen	322.5	17.1	154.1	25.2	46.12	72.12	39.01
T_5-50% RDF + Vermicompost (1.5 t ha^{-1})	329.6	18.8	157.2	25.0	51.98	73.93	41.28
T_6-50% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1})	336.3	19.7	160.0	25.4	62.86	74.56	45.74
T_7-75% RDF +Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1})	338.0	20.6	170.6	25.8	64.56	75.32	46.15
T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB	352.8	21.1	172.9	26.0	68.61	75.91	47.47
SE ±	5.08	0.7	3.4	0.78	1.23	1.25	-
CD (at 5%)	15.10	2.1	10.4	NS	3.52	3.57	-

Table 3: Effect of treatments on quality parameters and economics of rice

Treatments	Grain protein content (%)	Cost of cultivation (Rs ha^{-1})	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T_1-Control (No application of fertilizer)	7.15	36280	68689	32409	0.89
T_2-50% Nitrogen (Urea)	7.42	38411	95197	56786	1.48
T_3-75% Nitrogen (Urea)	7.44	38878	100080	61202	1.57
T_4-100% Nitrogen	7.51	39744	102739	62995	1.59
T_5-50% RDF + Vermicompost (1.5 t ha^{-1})	7.42	45509	114911	69402	1.53
T_6-50% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1})	7.61	48577	137182	88605	1.82
T_7-75% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1})	7.79	49594	140741	91147	1.84
T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB	7.83	52996	149074	96078	1.81
SE ±	0.49	-	-	-	-
CD (at 5%)	NS	-	-	-	-

Effect of treatments on yield and yield attribute of rice

Increases in the growth-related characteristics (plant height, dry matter accumulation, and number of tillers) eventually showed up in the yield-related characteristics *viz.* number of panicles m^{-2}, panicle length (cm), number of grains panicle^{-1} and test weight; which were recorded higher (352.8, 21.1, 172.9 and 26.0 respectively) with application of 75% RDF + Green Leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB. It could be because of the intricate interactions between its constituent parts, which are influenced by the development cycle during vegetative stages and manifested during productive phases. Numerous factors that contribute to development and output were enhanced by various types of organic and inorganic manure. A number of researchers, including (Kundu *et al.* 2016, Mahmud *et al.* 2016 and Dekhane *et al*. 2015) [12, 13, 7].

The sum of all agronomic inputs that affect a crop's growth and yield-attributing characteristics during its life cycle is its yield. The contribution of several elements to economic yield is used to rate each one's effectiveness. Higher seed yield, stover yield and harvest index (68.61, 75.91 q ha^{-1} and 47.47% respectively) were obtained with application of 75% RDF + Green Leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB. Rice yield increased as a result of nutrient management practices that had a positive impact on several yield-contributing characters, including the number of panicles (m-2), the length (cm) of the panicles, the number of grains (pample-1), the test weight, and growth characters (plant height, tiller count and accumulation of dry matter). Venkatesha *et al.* (2015) [16], Balamurugan *et al.* (2018) [5] and Kumar *et al.* (2017) [11] have previously reported on this impact of organic and inorganic treatment on rice output.

Effect of treatments on plant-nutrient-uptake of rice

Significantly higher uptake of nitrogen, Phosphorous and potassium (144.7, 29.1 and 144.3 kg ha^{-1}) by crop was under treatment T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB over other control. The use of organic fertilizer in addition to inorganic fertilizer increased enzymatic activity and N-absorption, resulting in improved N-uptake (Gautam *et al.* 2005) [9]. Despite the fact that both organic and inorganic fertilizer treatment had a significant impact on plant P concentration, the yield varied significantly, which eventually led to the plants absorbing P more effectively.

Effect of treatments on quality parameters and economics of rice

Under T8: 75% RDF + Green Leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB, a numerically greater protein content (7.83%) was observed. It can be because there is a superior supply of nutrients or because rice has more protein % (Zaidi *et al*. 2016) [17].

Maximum cost of cultivation (52996 Rs ha^{-1}) was recorded

under T_8-75% RDF with Green Leaf Manure (2.5 t ha^{-1}), Vermicompost (2.5 t ha^{-1}) and PSB treatment however minimum cost of cultivation (36280 Rs ha^{-1}) recorded under T_1-Control (No application of fertilizer). The cost of cultivation was high because more quantity of organic and inorganic fertilizes which increases the cost of cultivation of corresponding treatments. Maximum gross return (149074 Rs ha^{-1}) and net return (96078 Rsha^{-1}) were recorded under T_8-75% RDF with Green Leaf Manure (2.5 t ha^{-1}), Vermicompost (2.5 t ha^{-1}) and PSB treatment. Whereas, minimum gross return (68689 Rs ha^{-1}) and net return (32409 Rs ha^{-1}) recorded T_1-Control (No application of fertilizer). Gross return and net return were more due to higher production seed yield of rice crop. Higher B: C ratio (1.84) was recorded with application of T_7-75% RDF +Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1} and minimum (0.89) recorded with T_1-Control (No application of fertilizer) of rice. It might be due to the cost of cultivation was least to T_8-75% RDF with Green Leaf Manure (2.5 t ha^{-1}), Vermicompost (2.5 t ha^{-1}) and PSB treatment and profitable as compared to other. The effect of combination of organic and inorganic fertilizer on economics was also included by Kundu *et al.* (2016) [12] and Venkatesha *et al.* (2015) [16].

Conclusion

It can be concluded from the present investigation that organic and inorganic fertilizer practices with T_8-75% RDF + Green leaf Manure (2.5 t ha^{-1}) + Vermicompost (2.5 t ha^{-1}) + PSB increases growth attributing characters at different crop stages and yield attributing characters at harvest along with higher seed, straw yield with quality parameters (protein and oil content) & net return. In terms of benefit cost ratio treatment T_7-75% RDF + Green leaf Manure (1.5 t ha^{-1}) + Vermicompost (1.5 t ha^{-1}) was produced maximum B: C ratio.

References

1. Alexandratos N, Bruinsma J. World Agriculture Towards 2030/2050: The 2012 Revision. ESA Working Paper, FAO, Rome; c2012. p. 12-03.
2. Anonymous. Department of Agriculture, Cooperation & Farmers' Welfare; c2020.
3. Ashwini M, Sridhar CJ, Saraswathi Mamathashree CM, Nethravathi B. Effect of enriched FYM and fertilizer levels on growth and yield components of aerobic rice (*Oryza sativa* L.). Ecoscan. 2015;8:153-159.
4. Aulakh MS. Integrated nutrient management for sustainable crop production, improving crop quality and soil health, and minimizing environmental pollution. In 19th World Congress of Soil Science, Soil Solutions for a Changing World; c2010. p. 1-6.
5. Balamurugan R, Babu R, Swaminathan C, Baskar K, Gopal NO. Performance of organic nutrition on physiological characters and yield; c2018.
6. Bharat Lal, Vinod Nayak, Priyanka Sharma, Tedia K. Effect of combined application of FYM, fly ash and fertilizers on soil properties and paddy grown on degraded land. Curr. World Environ. 2014;9(2):531-535.
7. Dekhane SS, Patil NB, Jadhav KP, Patel DJ. Effect of organic and inorganic fertilizers on growth and yield of paddy. International Journal of Tropical Agriculture. 2015;33(1):149-151.
8. FAO. World Food and Agriculture - Statistical Yearbook. Rome; c2020. https://doi.org/10.4060/cb1329en.
9. Gautam AK, Mishra BN, Mishra PK. Influence of plant spacing and levels of nitrogen on grain yield and nitrogen uptake of inbred and hybrid aromatic rice. Annals of Agriculture Research, New Series. 2005;26(3):421-423.
10. Harikesh A, Ali SR, Yadav P, Kumar S, Kumar A, Yadav A. Effect of Integrated Nutrient Management and Plant Geometry on Growth and Quality of Rice (*Oryza sativa* L.) Varieties under SRI Technique. Int. J Curr. Microbiol. App. Sci. 2017;6(10):2503-2515.
11. Kumar A, Dhyani BP, Rai A, Kumar V. Residual Effect of Applied Vermicompost and NPK to Rice on Growth and Yield of Succeeding Wheat and Chemical Properties of Soil. Int. J Curr. Microbiol. App. Sci. 2017;6(11):1087-1098.
12. Kundu A, Roy AKS, Patra PS. Responses of integrated nitrogen management on the performance of aromatic rice varieties under terai zone of West Bengal. International Journal of Science, Environment and Technology. 2016;5(4):2406-2414.
13. Mahmud AJ, Shamsuddoha ATM, Haque MN. Effect of Organic and Inorganic Fertilizer on the Growth and Yield of Rice (*Oryza sativa* L). Nature and Science. 2016;14(2):45-54.
14. Pode R. Potential applications of rice husk ash waste from rice husk biomass power plant. Renewable and Sustainable Energy Reviews. 2016;53:1468-1485; 113(49), 14145-14150.
15. Siddaram Reddy VC, Krishna Murthy N. Effect of farmyard manure and bio-digester liquid manure on soil health under aerobic rice-field bean cropping sequence. Int. J Curr. Microbiol. App. Sci. 2010;6(5):684-693.
16. Venkatesha MM, Krishnamurthy NG, Tuppad B, Venkatesh KT. Yield, economics and nutrient uptake of aerobic rice cultivars as influenced by INM practices. Res. Environ. Life Sci. 2015;8(1):113-118.
17. Zaidi SFA, Kumar S, Bharose R, Kumar R, Singh G, Verma KK. Effect of different nutrient resources on yield and quality of basmati/aromatic rice in inceptisol of Eastern Uttar Pradesh, An Asian Journal of Soil Science. 2016;11(1):230-234.